

and regular as that given by Roberts at p. 350 of *Monthly Notices*, in the first of the papers previously referred to. The brightness undoubtedly varies in different periods, and I think the general curve is subject to minor irregularities, as in the case of *U Orionis*.

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*Observations of Nebulæ.* By Herbert A. Howe.

(Communicated by the Secretaries.)

The following notes are in continuation of those published in the April, 1898, number of the *Monthly Notices*, and were made in the course of my observations upon nebulae, during the first six months of 1898. The numbers, as previously, are the current ones of the N.G.C., except those which are enclosed in brackets, which refer to Dreyer's Index Catalogue in vol. li. of the *Memoirs of the R.A.S.* When, instead of a number, the name Swift is given, reference is made to objects recently discovered at the Lowe Observatory, found in lists published from time to time in various periodicals, chiefly in the *Monthly Notices*.

As the positions of so many of the nebulae in my working list are erroneous, because of the inaccurate places given by the discoverers, I have striven not to add new errors by mistakes of my own, and have therefore determined the position of each comparison star twice, once by means of the circles of the instrument, and a sidereal watch, and a second time by connecting it with some catalogue star by chronographic and micrometric measures. There are two checks against gross errors in the micrometric measurements between each nebula and its comparison star. These are, firstly, independent estimates of  $\Delta\alpha$  and  $\Delta\delta$  by the help of the known intervals between the micrometer wires, and, secondly, sketches of the field of view. In a few cases a larger telescope, or a keener eye, may be needed to settle doubtful points. All positions are referred to the mean equinox of 1900.0.

The new Bruce micrometer, to which reference was made in my former communication, has now been in use for six months, and has proven itself to be a most admirable instrument. It has a set of eleven wires in R.A., and nine in declination, the latter spanning a space of  $30'$ ; the sets can be illuminated separately or simultaneously, with any desired intensity. The micrometer screw has movable heads, so that three bisections can be made before the readings are taken. The box can also be revolved just  $90^\circ$ , without reading the position-circle.

(195) and (196). These two nebulae were not at all difficult to see, and I found no others in their neighbourhood. Hence I assume the ones which I observed to be those found by

Swift, though their relative positions are not as given by him. Their positions are :—

$$\begin{aligned} &1^{\text{h}} 58^{\text{m}} 20^{\text{s}}, +14^{\circ} 13'.7, \\ &1^{\text{h}} 58^{\text{m}} 25^{\text{s}}, +14^{\circ} 15'.5. \end{aligned}$$

1121. The position is  $2^{\text{h}} 45^{\text{m}} 35^{\text{s}}, -2^{\circ} 8'.8$ .

1337. Swift described this as "m E n s." I estimated the elongation to be at  $135^{\circ}$ .

(346). I measured (345), and its place agrees with that given by Dreyer within  $1'$ . But in the place of (346), which was presumably discovered by Professor Stone at the same time, I saw nothing but faint stars. The seeing was excellent, and Professor Stone described (346) as brighter than (345).

1489. The position is  $3^{\text{h}} 53^{\text{m}} 11^{\text{s}}, -19^{\circ} 30'.3$ .

1518. The elongation is at  $200^{\circ}$ . The position is  $4^{\text{h}} 2^{\text{m}} 29^{\text{s}}, -21^{\circ} 26'.6$ .

1561-5. I could not see all the nebulae in this group, but found a new one near by. Since the positions of these nebulae are poor, a large telescope may well give attention to them.

1592. In the place given for this I found only small stars. 1591, near by, was observed.

1614. The position is  $4^{\text{h}} 29^{\text{m}} 11^{\text{s}}, -8^{\circ} 47'.3$ .

1619. In the place given for this I saw only stars of mags.

13-14. Its neighbour, 1627, was readily seen.

1689. Swift called this "pB." I searched for it on two nights without success. Probably there was an error of just  $5^{\text{m}}$  in its R.A., and it is identical with 1667, which has the same declination.

1729. The N.G.C. description is "vF, pL, 2 B st v nr." My description was "F, pS, R, with nucleus of mag. 13.5." It is in line between two stars of mags. 8.5 and 9 respectively, the former preceding it  $20^{\text{s}} \pm$ , on nearly the same parallel, and the latter following it  $4^{\text{s}}$ .

1738. The position is  $4^{\text{h}} 57^{\text{m}} 22^{\text{s}}, -18^{\circ} 18'.1$ .

1739. The position is  $4^{\text{h}} 57^{\text{m}} 23^{\text{s}}, -18^{\circ} 18'.7$ .

1744. This is very large, faint, and ill defined. But it contains a nuclear point of mag. 12.8. The position is  $4^{\text{h}} 55^{\text{m}} 52^{\text{s}}, -26^{\circ} 10'.4$ .

1781. On two nights I was unable to find this, though I measured 1794, which is similar in description. As the N.G.C. R.A. of 1781 differs from my R.A. for 1794 by  $3^{\text{m}}$ , and the declinations of the two objects differ by less than  $1'$ , it is probable that H. made an error of  $3^{\text{m}}$  in the place of 1781.

1794. The position is  $5^{\text{h}} 3^{\text{m}} 31^{\text{s}}, -18^{\circ} 19'.2$ .

2054. I saw only three small stars. The 9 mag. star which Bond said to be  $7'$  north was seen.

2124. H.'s description is "eeF, pS, E, r," while I called it simply "F, S." However, I noticed a star of mag. 14 just south, and one of mag. 13 40" further south. A rude representation of the nebula, which I drew, makes it elongated at  $180^\circ$ . Its position is  $5^h 53^m 33^s$ ,  $-20^\circ 5'6$ .
- Swift. This is in Swift's List No. 6. Its position is  $5^h 53^m 43^s$ ,  $-23^\circ 11'4$ .
- Swift. This is in Swift's List No. 6. Its position is  $5^h 56^m 59^s$ ,  $-23^\circ 40'5$ .
2179. *h.* described this as "vmE." I looked carefully for elongation, and could perceive none. Two 12 mag. stars flank the nebula, on opposite sides; perhaps *h.* thought them to be portions of the nebula.
2206. This contains a 13.5 mag. double star, whose angle is  $80^\circ$ , and distance 10".
2207. This is binuclear at  $260^\circ$ ; the following nucleus is the brighter.
2211. The position is  $6^h 14^m 8^s$ ,  $-18^\circ 29'8$ .
2237. This seems to be the brightest point in a large nebulous region, which covers the entire background of the sky in this vicinity, though not with even brilliancy. Swift described it as a part of a ring surrounding a cluster. This appearance I could not verify, possibly because my field of view is much smaller than his. The position is  $6^h 25^m 21^s$ ,  $+5^\circ 4'9$ .
2280. *h.* described this as "1E." It appeared to me to be very narrow, and elongated at  $160^\circ$ , the southern end being extremely faint, and terminating at or near a star of mag. 13.5. But the definition was poor when I observed it, so that I may have missed faint lateral nebulosity, which would make the nebula appear less narrow.
2295. This nebula precedes the double 2292-3, instead of following it. The note in the N.G.C. should read, "D neb f." In other particulars the N.G.C. descriptive notes on these nebulae agree with my observations. The position of 2295 is  $6^h 43^m 23^s$ ,  $-26^\circ 37'6$ .
2292. The position is  $6^h 43^m 39^s$ ,  $-26^\circ 38'1$ .
2293. The position is  $6^h 43^m 42^s$ ,  $-26^\circ 38'6$ .
2296. The position is  $6^h 44^m 12^s$ ,  $-16^\circ 47'3$ .
- (454). One or two stars are involved in this nebula. Its position is  $6^h 45^m 28^s$ ,  $+13^\circ 2'4$ .
2325. *h.* called this "1E." To me it appeared round, with two 13 mag. stars near by, on opposite sides of it, at angles of  $160^\circ$  and  $340^\circ$  respectively.
2327. The double star involved in this very faint nebula is of mags. 9 and 12, at an angle of  $110^\circ$ , and distance of 7".
- (468). This nebula of Bigourdan's is supposed to precede 2361 by a little over 1". But I could not find any such object, though I examined the vicinity on three nights.

- 2359 and 2361. In the N.G.C. 2359 is called "vv L," but there is apparently an error of  $1^m$  in its R.A. When Bigourdan discovered 2361, he probably thought it different from 2359, because the R.A. which he obtained was  $1^m$  different. 2361 is really a small condensation in 2359. I examined these objects on three nights, one of which was exceptionally fine.
2382. I searched for this on two nights (on one of which the definition was good) in vain; on each occasion I saw 2380, which has a similar description, and was an easy object. I called it "pB, with good nucleus."
2409. This consists of ten scattered stars.
2438. In the N.G.C. this is described as a planetary nebula. I found it to be nearly uniform in brightness, but darker in the centre. It contains two stars of mags. 13 and 14 respectively, and many more were suspected. It is slightly elliptical at  $135^\circ$ . It lies in the elegant cluster 2437, and is one of the prettiest objects in the sky.
2440. In the N.G.C. this is described as a planetary nebula, which is not very well defined. I found it to be binuclear at  $160^\circ$ . There is also a very faint condensation at the preceding end of the nebula. The object is small, greenish, and very bright.
2470. The elongation is at  $120^\circ$ . A double star of mag. 9, angle  $220^\circ$ , and distance  $3''$ , precedes it  $11^s$ ,  $1'4$  north.
2491. Swift calls this "eeF," and puts it  $15^s$  preceding 2496, and following a "B \*." 2496 was easily found near the place assigned for it; the "B \*" appeared to be of mag. 10, and 2491, after careful scrutiny on a fine night, resolved itself into a few stars of mag. 14.
2496. My description tallies with Swift's, except that he says "★ close f," while I found a star of mag. 11,  $3^s$  preceding.
- (487). Swift described this as round; it is elongated at  $110^\circ$ .
2506. *h.* corrected his N.P.D. of this object by  $-10'$ , to make it agree with that found by Harding and H., and the N.G.C. has followed him. As the cluster, when searched for, was evidently not at this N.P.D., I took a single careful reading of the declination circle, which put it  $10'$  farther south. The N.P.D. should therefore be  $100^\circ 24'4$  in the N.G.C.
2564. This is described in the N.G.C. as "vF, S, R, gbM." I found it to be extremely small, and elongated at  $90^\circ$ ; it looked quite like a faint close double star.
2566. The N.G.C. description is "vF, cL, er." I found here two objects of mags. 11 and 12 respectively. The brighter one is certainly a very small nebula, or nebulous star. I could not be certain that its nebulosity extended to the 12 mag. star. This object was examined on three nights, two of which were fine.

2610. The 7.5 mag. star near this nebula is Schjellerup 3139, the catalogue position of which agrees with the circle-readings of my instrument ; there is no other bright star in the neighbourhood. Therefore the N.G.C. place of the nebula is erroneous. The correct position is  $8^h 28^m 42^s$ ,  $-14^\circ 53' 8''$ .
2616. Swift called this "R." To me it appeared elongated at  $180^\circ$ , having the appearance of a very faint nebulous double star, having a distance of  $10''$ .
2662. I searched in vain for this, in the place given in the N.G.C., on three nights, and finally found it  $10'$  north of its supposed location. The star mentioned by *h.* is of mag. 13, and precedes  $2^s$ , a trifle north. The position of the nebula is  $8^h 40^m 52^s$ ,  $-14^\circ 45' 4''$ .
2690. The position is  $8^h 47^m 35^s$ ,  $-2^\circ 13' 6''$ .
2848. In measuring this I bisected the brightest spot in it ; perhaps that is 2847. Dreyer saw a star of mag. 11-12,  $3'$  n.f. ; I saw two stars there, n.f. the brightest part of the nebula, near its edge, and possibly involved in it.
2978. The position is  $9^h 38^m 23^s$ ,  $-9^\circ 17' 3''$ .
3143. The position is  $10^h 5^m 10^s$ ,  $-12^\circ 5' 3''$ .
3292. The elongation is at  $180^\circ$ . The position is  $10^h 30^m 33^s$ ,  $-5^\circ 39' 6''$ .
3321. The main body of the nebula appeared to lie about  $15''$  from the n.p. star (of mag. 12) which Leavenworth noted, at an angle of  $135^\circ$ . I was not sure that the nebulosity extended clear up to the star ; I observed it on two nights. The position is  $10^h 33^m 52^s$ ,  $-11^\circ 7' 4''$ .
3322. I searched for this on two evenings without success. On each evening 3321 was seen. Their descriptions are similar, and their right ascensions agree fairly ; I am inclined to think them the same, though Common's approximate declination for 3322 differs from mine for 3321 by over  $15'$ . There is a like discrepancy between his observations and mine in the case of his pair 3360-1.
- 3360 and 3361. I found the declination of 3361 to be  $-10^\circ 40' 9''$ , which is  $14'$  greater than Common's estimate. It is much elongated at  $160^\circ$  ; a star of mag. 13 precedes it a trifle, and a 10 mag. star, which was suspected to be a close double at  $130^\circ$ , follows it several seconds, on nearly the same parallel. 3360 is round and very faint. It precedes 3361 about  $10^s$ ,  $1'$  or  $2'$  south. The R.A. of 3361 is between  $10^h 39^m 25^s$  and  $10^h 30^m 30^s$ .
3404. The position given in the N.G.C. for this Common nebula is only approximate. I had only faint suspicions of a nebula in that position, and found a nebula near by, which, as it is pretty bright, and much elongated at  $90^\circ$ , I assume to be 3404. Its position is  $10^h 45^m 20^s$ ,  $-11^\circ 34' 7''$ .



3421 and 3422. I could see nothing in the N.G.C. places for these Common nebulae, on either of two nights. I found one very faint, round, and small nebula at  $10^h 46^m 0^s$ ,  $-11^\circ 55' 1''$ . The position of this was measured on two nights. A star of 12 mag. follows it about  $4^s$ . On the first night I suspected an extremely faint nebula  $1' 5''$  north of it. On the second night I suspected another preceding the known nebula  $12^s$ ,  $2'$  south, but the definition was poor, and it may have been a star.

3546. The position is  $11^h 4^m 47^s$ ,  $-12^\circ 50' 1''$ .

3704. I have looked in vain for this on two nights, on each of which its neighbour 3707 was very easily seen and measured. It was called "pB" on one of the nights. I saw also the 9 mag. star which is said to be " $2' \text{ ssf}$ " 3704. Yet both Tempel and Common call 3704 " $vF$ ," the same designation which they apply to 3707. Is it possible that 3704 is variable?

3711. The position is  $11^h 24^m 22^s$ ,  $-10^\circ 31' 3''$ .

3779 and (717). These nebulae may be identical, since each discoverer obtained only an approximate place of his nebula. I saw with assurance only one nebula, though I suspected another between it and 3775. The position is  $10^h 33^m 47^s$ ,  $-10^\circ 1' 7''$ .

4038 and 4039. This is a remarkable double nebula. 4038 seems the larger. 4039 is elongated at  $220^\circ$  in comet fashion. 4038 has a faint condensation near its centre; two other condensations were suspected preceding and following it. Both are very diffuse, and at times their outlines appear to meet. The definition was only fair when these were examined.

4263 and 4265. I saw only one nebula here. It appeared to be elongated at  $90^\circ$ . I sometimes suspected that this elongation might be the result of duplicity, but the object was very diffuse, and gave no certain indication of doubling.

4722 and 4723. The N.G.C. place for these is only approximate, and Tempel evidently considered them as constituting a double nebula, each component being  $vF$ ,  $vS$ . I found only one nebula, which was followed at an interval of  $4^s$  by a star of mag. 11.5. The position of the nebula is  $12^h 46^m 19^s$ ,  $-12^\circ 47' 1''$ .

4726. The N.G.C. place of this nebula of Tempel's seems to be considerably out, both in R.A. and declination. The correct position is  $12^h 46^m 18^s$ ,  $-13^\circ 40' 6''$ .

4740. Near the place given for this in the N.G.C. are Nos. 4724, 4726 and 4727, together with a new one which I discovered. I could not find 4740, but found a nebula approximately  $15'$  south and  $20^s$  preceding, which tallied with Swift's description of 4740; (this is not the new one mentioned above). This entire region deserves careful

observation with a large telescope, because of the presumed errors in the places of 4726 and 4740.

Swift. In Swift's List No. 8, published in the 1898 March number of the *Monthly Notices*, is a nebula at  $14^h 6^m 50^s$ ,  $-30^\circ 3' 33''$ . Though he called it only "F," I saw nothing in this place, the nearest object being 5494, which is in the same field. They may be identical.

Swift. This is No. 25 in Swift's List No. 8 just mentioned.

Its position is  $14^h 28^m 39^s$ ,  $-27^\circ 4' 8''$ .

(1077). The position is  $14^h 51^m 43^s$ ,  $-18^\circ 48' 6''$ .

(1081). The position is  $14^h 53^m 16^s$ ,  $-18^\circ 50' 4''$ .

5898. This has a fine nucleus. Its position is  $15^h 12^m 22^s$ ,  $-23^\circ 43' 9''$ .

(1115). Swift's description is "eeF, S, R, pB \* sf." I found only a double star of mags. 12.5 and 13.5, with angle  $315^\circ$ , and distance  $5''$ . A star of mag. 8.5 follows  $7^s$ ,  $2' 5''$  south. The night was clear and the definition fair.

5926. The position is  $15^h 18^m 41^s$ ,  $+13^\circ 4' 3''$ .

6065 and 6066. Dreyer's note on these nebulae, on p. 227 of vol. li. of the *Memoirs of the R.A.S.*, leads me to give their true positions. 6065 is at  $16^h 2^m 45^s$ ,  $+14^\circ 9' 3''$ . 6066 is at  $16^h 2^m 57^s$ ,  $+14^\circ 12' 7''$ .

6224. The position is  $16^h 43^m 26^s$ ,  $+6^\circ 29' 4''$ .

6225. A double, of 13 mag. stars, is involved; its angle is  $90^\circ$ , and distance  $10''$ . The position is  $16^h 43^m 29^s$ ,  $+6^\circ 24' 0''$ .

6294. This follows 6293 closely, and appears to be simply a very faint double star of mags. 13 and 13.5, with an angle of  $315^\circ$ , and distance of  $8''$ .

(1243). This was examined on two nights. It consists of five 12-14 mag. stars in a line, at an angle of  $0^\circ$ , the length of the line being  $45''$ . A star of mag. 14 immediately precedes the northern end of the row.

6309. This is a close double nebula, at an angle of  $160^\circ$ . Both objects are extremely small, and are also bright.

6355. This appeared to be an extremely faint small round cluster of very small stars, having many outliers on the north, and some on the south also.

6401. This has a nucleus of mag. 13.5, at an angle of  $315^\circ$  from the 10.8 mag. star, which lies on the south following border of the nebula.

6476. I examined this region for quite a while, on a fine night. Large areas appeared to have a nebulous background, or else to be covered with myriads of very minute stars; I could not decide which was the case. I came across a small but striking "Loch im Himmel," at  $17^h 55^m 0^s \pm$ ,  $-28^\circ 35' \pm$ .

6526. This appeared to me not to be a nebula, but simply an aggregation of very faint stars.

(1290). This is simply a cluster of half a dozen small stars from mag. 12 down.

6717. The cluster in this nebula is composed of five stars of mag. 12. The southernmost two form a double of angle  $0^\circ$  and distance  $3''$ . Two others form another double of angle  $340^\circ$  and distance  $2''$ . The nebulosity surrounding these is very faint and formless.

Swift. In Swift's List No. 2, at  $19^h 22^m 0^s$ ,  $-36^\circ 24'.1$ , there is an object which he described as "B, eS, vE, stellar, close nebulous D\*?" In this position I found nothing, but about  $20^s$  preceding it there seemed to be a close double, the star being elongated at  $100^\circ$ .

6797. This was discovered by Peters, and was described as "a neb. with 9 mag. \* att. f." I could see no trace of nebulosity, but the 9 mag. \* was preceded by a double of mag. 13, angle  $180^\circ$ , and distance  $10''$ .

6816. In this is a star of mag. 13.5. *h.* noted a " \* np." I saw only a star of mag. 14 at an angle of  $20^\circ$  and distance of  $30''$ . The sky was dull, so that the nebula was difficult to measure.



*List of Nebulae discovered at the Chamberlin Observatory,  
University Park, Colorado. By Herbert A. Howe.*

(Communicated by the Secretaries.)

While observing nebulae and comets with the 20-inch refractor, I have from time to time chanced upon new nebulae, a list of which follows. The positions of all, with one exception, have been micrometrically measured, and are given for 1900.0.

No.	Date.	R.A.	Dec.	Description.
	1895.	h m s	° ' "	
1	Jan. 15	0 48 17	+ 5 13.7	eF, S, bet st 12 <sup>m</sup> and 13 <sup>m</sup>
2	15	0 49 32	+ 5 13.9	11 <sup>m</sup> nebulous *. 9 <sup>m</sup> * p 10 <sup>s</sup> , 4' 5 n.
3	June 24	0 53 41	+ 0 2.8	vF, cS, R, lbM.
4	July 3	1 21 41	- 4 1.3	12 <sup>m</sup> nebulous *. FD * 2' nf.
5	1898. Jan. 14	4 18 7	-15 53.8	eF, vS. Near N.G.C. 1561-5.
6	Feb. 22	5 27 54	-13 59.9	vF, S. Near N.G.C. 1954 and 1957.
7	11	6 12 14	-21 20.4	eF, pS, f N.G.C. 2207 7 <sup>s</sup> .
8	16	8 14 31	-25 3.4	pB, vS, R, lbM, 6' n of N.G.C. 2566.
9	22	8 21 37	-12 58.5	F, vS, elongated at 90°, 1st of 3.
10	22	8 21 44	-12 58.7	eF, vS, 2nd of 3.
11	22	8 21 45	-12 57.9	vF, vS, 3rd of 3.
12	Mar. 23	8 41 30	-14 59.4	vF, eS, 1E.
13	Feb. 23	9 0 58	-18 48.4	F, vS, R, 10' s of N.G.C. 2754, 2757, and 2758.
14	Apr. 25	11 10 32	-13 37.5	eF, S.
15	20	12 45 44 ±	-13 56	F, S, R, n of 11 <sup>m</sup> *.
16	1897. Oct. 19	21 3 40	-23 17.1	eF, vS, diffie.
17	Sept. 30	21 34 15	-22 52.7	eeF, S, diffie. In field with N.G.C. 7103 and 7104. Another susp. 1' s.
18	Oct. 20	22 7 0	-23 27.1	eF, vS, f N.G.C. 7220 63 <sup>s</sup> .
19	Sept. 27	23 15 30	-22 41.8	eF, eS, nearly stell., 13 <sup>m</sup> ; 9.5 <sup>m</sup> , 5' n.
20	28	23 18 55	-12 24.6	vF, vS, f 9.5 <sup>m</sup> * 1 <sup>s</sup> .
21	1894. Dec. 14	23 29 28	- 5 5.2	nebulous * 10.5 <sup>m</sup> . Possibly close D *. Extended nebulosity susp. at 135° and 315°.
22	1897. Oct. 1	23 46 20	-13 56.2	F, vS, R, bM = * 12.5 <sup>m</sup> .

SSS 2